Trust Guideline for the Management: of Massive Blood Loss in Children (C-MBL)

For Use in:	Theatres, Intensive Care, Accident and Emergency
By:	Medical and Nursing Staff, ODAs, OPDs, Laboratory Staff Blood Transfusion Committee and paramedics
For:	Paediatric patients undergoing massive blood transfusion
Division responsible for document:	Surgical Division
Key words:	Blood Transfusion, Major Haemorrhage, Paediatrics
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If Yes - does the strategy/policy deviate from the recommendations of NICE? If so why?	N/A

***** Please note there are separate guidelines/protocol for Adults (click here)**

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***** Please note there are separate guidelines for Obstetric patients (click here)**

This guideline has been approved by the Trust's Clinical Guidelines Assessment Panel as an aid to the diagnosis and management of relevant patients and clinical circumstances. Not every patient or situation fits neatly into a standard guideline scenario and the guideline must be interpreted and applied in practice in the light of prevailing clinical circumstances, the diagnostic and treatment options available and the professional judgement, knowledge and expertise of relevant clinicians. It is advised that the rationale for any departure from relevant guidance should be documented in the patient's case notes.

The Trust's guidelines are made publicly available as part of the collective endeavour to continuously improve the quality of healthcare through sharing medical experience and knowledge. The Trust accepts no responsibility for any misunderstanding or misapplication of this document.

Version and Document Control:

Version Number	Date of Update	Change Description	Author
4	09/11/2020	Key personnel amended and reference updated, flowchart reconstructed	Dr S J Wilson Debbie Asher Dr Suzanne Doherty

This is a Controlled Document

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Quick Reference

Definition: Massive blood transfusion is defined as a blood loss of:

- Greater or equal to 150 mL per minute OR
- 100% blood volume per 24 hours OR
- 50% blood volume in 2 hours

Where blood volume is:

Child = 80mL per kg

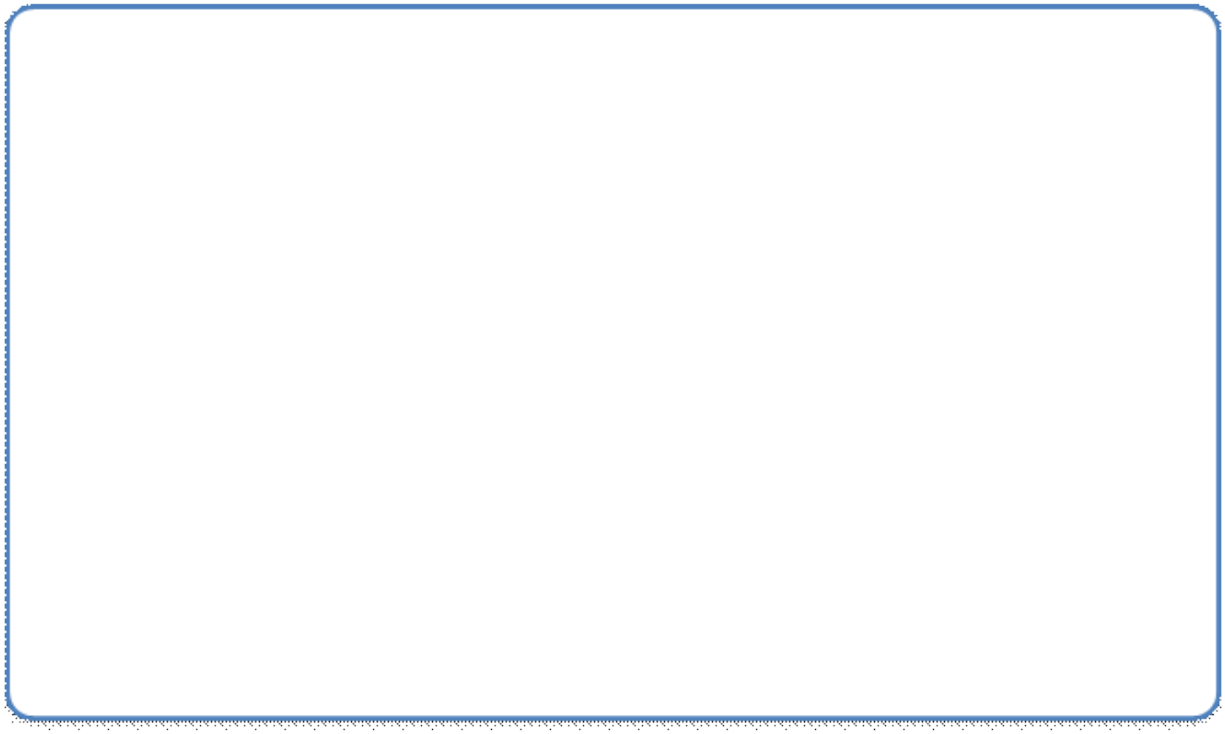
Neonate = 90mL per kg

Glossary

ABG	Arterial Blood Gas
APTT	Activated Partial Thromboplastin time
BV	Blood Volume
CBV	Child's Blood Volume
CNS	Central Nervous system
CVP	Central Venous Pressure
DIC	Disseminated Intravascular Coagulation
ECG	Electrocardiogram
EDTA	Ethylenediamintetraacetic acid
FBC	Full Blood Count
FFP	Fresh Frozen Plasma
Hb	Haemoglobin
HES	Hydroxy Ethyl Starch
INR	International Nationalised Ratio
NCCG	Non-Consultant Career Grade
ODP	Operating Department Practitioner
$p0_2$	Partial Pressure Oxygen
PT	Prothrombin Time
PRBCs	Packed Red Blood cells
PLTs	Platelets

Adapted from of E of E MH Children

https://www.transfusionguidelines.org/uk-transfusion-committees/regional-transfusion-committees/east-of-england/policies



Reconstructed with kind permission from Clare Neal, RTC Administrator – East of England NHS Blood and Transplant

Table 1: Goals 1- 4 (Table 1) should be dealt with simultaneously

The massive blood loss protocol will be applied when there is an **'actively bleeding patient in whom transfusion has started and needs to continue'**.

Blood bank must be informed using the trigger phrase to activate the massive blood loss protocol; "***I want to initiate the children's massive blood loss (C-MBL) protocol." The weight, age and location of the child must also be provided.***

All subsequent communications between clinical areas and laboratory staff should be preceded by the trigger phrase "*This call relates to the C-MBL protocol".* A specific member of the team should be nominated **to co-ordinate communication with the laboratory staff and support services.**

Goal	Action	Comments
1. Restore circulating volume	• 2 wide bore cannulae or intraosseous access • Send blood bank sample if not done: 6ml in pink EDTA bottle. • Also include FBC, APTT and INR	It is essential that samples are sent to the blood transfusion lab as soon as possible
	• Give adequate (warm) crystalloid or colloid e.g. Gelofusine	e.g. 10-20 ml kg $^{-1}$ Use pressure bags Blood loss is often under-estimated Shock, hypothermia and acidosis increase risk of DIC.
	• Call for senior (on site) anaesthetist. • Maintain BP • Consider central venous line, arterial line • Measure urine output	
	• Consider use of cell saver	Cell saver is available in theatre; requires trained staff; most suitable in trauma/vascular bleeding See Trust guideline
	• Consider **early** use of Tranexamic Acid	Maximum benefit from Tranexamic Acid if given within first hour after injury. Do not give more than 3 hours after injury • Dose is an initial bolus of 15mg/kg (max 1g)
	• Consider reversal if on heparin/warfarin/other anticoagulants	CA2085:Anticoagulation with Warfarin including reversal
	• Consider active warming to prevent hypothermia	Use a blood warmer and external patient warming device.

2. Activate massive blood loss protocol and initiate transfusion	**State: 'I want to trigger the C-MBL protocol' to request major blood loss pack (MBL)** **Give 20ml/kg blood via fluid warmer** • **Give Group O Rh D negative if immediate need and/ or blood group unknown** • **Blood transfusion lab will provide group specific/ cross-matched red cells as required** **NOTE: for paediatric patients MBL packs will be issued as soon as the need for massive transfusion is identified**	Clearly state: ***"I want to trigger the C-MBL protocol!"*** **Week day extension: 2905/2906** Out of hours- BMS **(bleep 0670)** Aim to maintain Hb >80g/d O Neg blood available immediately and will continue to be supplied until group specific blood is available Uncrossmatched group specific blood available in 25 minutes Crossmatched blood available in 45 minutes
3. Continue transfusion with major blood loss packs	MBL pack A) 30ml/kg blood and 20ml/kg FFP MBL pack B) If a second or subsequent Major Blood Loss Pack is required these will contain • 30ml/kg blood • 20ml/kg FFP • 15ml/kg platelets (up to 1 adult dose) • Cryoprecipitate 10mg/kg (up to 1 adult dose) **IF COAG SCREEN IS NOT TAKEN, PLEASE DO SO!**	Aim to maintain Hb > 80 g/L Aim for PT and APTT <1.5X the control (keep ionized Ca^{2+} > 1.13 mmol/L FFP thawed in 20 – 30 min Anticipate PLTs < 50 X 10^9/L after 2 BV replacement, therefore: Aim PLTs > 75 X 10^9/L, **UNLESS** multiple or CNS trauma or if known PLTs dysfunction, in which case aim PLTs > 100 X 10^9/L Cryoprecipitate replaces fibrinogen and factor 8 Aim for fibrinogen >1.5g/ L Fibrinogen < 0.5g/ L strongly associated with microvascular bleeding Cryoprecipitate thawed in 20 – 30 minutes NB. The blood bank will issue compatible FFP and PLTs which will not necessarily be the same group as patient. Ensure Electronic Blood Tracking system is used throughout
4. Contact senior personnel	• Consultant anaesthetist • Consultant surgeon, gastroenterologist, obstetrician as appropriate • Blood bank	
5. Arrest bleeding	• Remember simple measures (pressure/elevation) can be useful • Early surgical intervention • Consider interventional radiology	

6. Repeat blood tests	• If continued oozing repeat FBC and Coag. screen every 4 hours or after every 30ml/kg of blood given • It is recommended to perform at least one set of tests <u>after</u> major transfusion • Serum Calcium and Potassium	Hypocalcaemia and hyperkalaemia can occur especially with hypothermia and acidosis. More common in neonates. Monitor ECG.
7. Suspect DIC	• Treat underlying cause (i.e. of blood loss)	Shock, hypothermia & acidosis increase risk

<u>Objective</u>

To ensure that a guideline is available to facilitate a multidisciplinary approach for the management of acute blood loss where immediate transfusion is required by employing a simple step by step flow chart. It is intended that the guideline is used alongside existing Trust policies for the checking and administration of blood and blood products[1]. (see Clinical guidelines on Trust Intranet)

<u>Rationale for the recommendations</u>

Avoidable deaths of patients with major haemorrhage are well recognised and locally agreed and/ or specialty specific guidelines are needed to ensure effective management.

This guideline is based on one produced in 1998 which was subsequently revised in 2008 in light of the guidelines issued by the British Committee for Standards in Haematology (National Blood Service) in 2006, and again in 2016, which remains of value in those Trusts using it[2]. It has been used as the basis for recent recommendations published by the UK Blood transfusion services[3]. Guidelines for perioperative management of haemorrhage in children were also consulted[4,5].

The recommendations contained in these guidelines must be regarded as level C, as they are based on uncontrolled observational studies and consensus of expert opinion (level 3 evidence). Well-designed case control studies and randomized clinical trials are lacking in this area.

National guidelines exist for the use of blood in the elective surgery [6] and should also be consulted. (www.sign.ac.uk)

<u>Broad recommendations</u>

Massive blood loss has been defined as the loss of one blood volume over 24 hours[7]. However >30ml/kg or > 40% circulating blood volume within 3 hours in infants and children [4,5] may be more useful working definitions in the acute situation[8]. Such definitions highlight the importance of early recognition of major blood loss and the need for effective action.

The initial priorities of treatment are:

1) Restoration of blood volume to maintain tissue perfusion and oxygenation

2) Achieving Haemostasis by:

- Early treatment of surgical bleeding.
- Correction of coagulopathy by the **early** use of blood component(s) therapy.

Detailed Recommendations

Restore circulating volume

Restoration of circulating volume will require the use of wide bore cannulae to access the circulation – either Intraosseous or venous -, and the rapid administration of (preferably warm) isotonic fluids and blood (once available).

Samples need to be sent urgently to blood bank if not already done so to provide blood and blood products of a correct group.

Blood loss is sometimes difficult to estimate and underestimates may be made if blood loss is within closed cavities. Monitoring the patient's CVP, arterial blood pressure and urine output (aim for 0.5-1mL/kg/hour in infants and children) may help in deciding on the adequacy of resuscitation and catheters should be inserted when appropriate by skilled medical personnel. Early consultation with senior colleagues (anaesthesia, surgery and blood bank) is mandatory.

Cell Salvage

Consideration should be given to the use of cell saver equipment in older children when appropriate. This is available in theatres and should be considered in most vascular and trauma cases. Contraindications are malignancy, contaminated fields and sickle cell anaemia. Cell salvage should be considered where more than 1000mls intra-operative blood loss is anticipated.

Antifibrinolytics

Early use of Tranexamic Acid should be considered. Maximum benefit is obtained if this is given within the first hour after injury. The dose is an initial bolus of 15mg/kg IV over 10 minutes (up to maximum of 1g) followed by infusion of 2mg/kg/hr IV for 8 hours or until the bleeding stops (max 1g).[21)]. Tranexamic Acid should not be given more than 3 hours after injury.[(22)] Tranexamic Acid may also be considered when giving blood is likely to be a problem (e.g. difficult antibodies or religious objection).

FFP

Based on current recommendations, FFP should be used early during massive blood transfusion [17, 18]. This is based on several large civilian and military retrospective studies which have shown improved survival when FFP is used in ratios of more than 1:2 (FFP:PRBCs) [19, 20].

Although FFP will be issued without clotting study results, samples should have been taken. 20mL kg-1 should be given[11]. FFP does not need to be Rhesus matched as there appears to be no risk of anti D immunization. Note; group O FFP is only issued

for group O patients as it has caused haemolysis in non-O patients. In other patients you will receive from blood bank FFP which is compatible but not necessarily identical with the patients group[12].

Platelets

Recommendations suggest that platelet therapy may be unnecessary in major blood loss situations unless the count is <75 x 10^9 (100 x 10^9 per litre in multiple and CNS trauma) [13, 14, 15] These guidelines, however, may not be easy to apply in a clinical setting [16]. Platelets are obtained from the NHSBT in Cambridge and take 1-2h to arrive. Stock platelets may be available immediately at the NNUH but if not, the triggering of the major blood loss protocol will ensure blood bank staff order platelets for the patient proactively and before an FBC demonstrates thrombocytopenia.

Blood Tests

Ideally FBC and clotting studies need to be repeated 4 hourly or after every 0.5 CBV has been replaced. FFP and platelets contain citrate anticoagulant (red cells in solution contain only traces of citrate). In theory, infused citrate could lower plasma ionised calcium levels, but in practice rapid liver metabolism of citrate usually prevents this. However, in neonates and patients who are hypothermic and/or acidotic, the combined effects of hypocalcaemia and hyperkalaemia may be cardiotoxic. Monitor acid base, serum calcium & potassium in these situations. If ECG shows evidence of hypocalcaemia, 0.1mL/kg (10%) calcium gluconate should be given by SLOW IV injection. The problem is best avoided by keeping the patient warm.

Cryoprecipitate

Cryoprecipitate is indicated when the plasma fibrinogen is less than 1.5 g $litre^{-1}$ and should be given in a volume of 1-1.5 packs per 10 kg body weight. Cryoprecipitate is now pooled (5u per pool) so children >30kg require two pools and children <30kg require one pool. If less than 1 year old, single units of cryoprecipitate are available. Throughout resuscitation and surgery it is important to maintain patient temperature by increasing the ambient temperature of theatre, the use of external patient warming devices and in line blood warmers.

Recombinant Factor VIIa

In life threatening haemorrhage refractive to other treatments Recombinant Factor V11a (Novo7) is available under restrictions within the Trust formulary, and must be discussed with a consultant haematologist. Please note that there is only sufficient Novo 7 for one bleeding episode in the Trust, and it must be given after other clotting factors have corrected any other coagulopathy. Clinical efficacy outside the setting of congenital coagulation disorders remains to be fully defined.

Disseminated intravascular coagulation

Disseminated intravascular coagulation occurs when an unregulated thrombin explosion causes release of free thrombin into the circulation. Widespread microvascular thrombosis leads to tissue ischaemia whilst the consumption of coagulation products and activation of fibrinolysis results in haemorrhagic complications. It is primarily a clinical diagnosis with laboratory tests being used to confirm the diagnosis and monitor replacement of blood products. In the peri-operative period the most likely cause of DIC will be either sepsis or trauma and treatment is that of the underlying cause. At the same time blood volume and tissue perfusion must be maintained whilst blood components are replaced in an attempt to correct the coagulopathy. Indications for treatment with heparin are not established.

<u>Clinical Audit Standards derived from guideline</u>

The reserve of platelets/ FFP and their ordering will be audited so that potential over ordering and cost can be established.

Delays in receiving platelets will need a DATIX raising for audit. All events which trigger the Massive Blood Loss protocol will be audited. 100% compliance with the guidelines will be used as the audit standard

Summary of development and consultation process undertaken before registration and dissemination

The guideline was drafted by the authors listed above on behalf of a guideline development group, which has agreed the final content. The guideline development group includes Transfusion Clinical Nurse Specialist, senior nursing staff and Operating Department Assistant (theatre).

During its development it was circulated for comment to: consultant, NCCG and trainee anaesthetists, consultants, nursing staff and laboratory staff in Haematology and Blood Transfusion, consultant surgeons (General, Urological, Thoracic, Orthopaedic, Plastics, Paediatrics), director and consultants Critical Care Complex) and consultants in Accident and Emergency.

The guideline has been presented in draft format at joint anaesthesia/ general surgery/ blood transfusion clinical governance meeting. This allowed time for discussion and comments were requested. It has also been presented to all members of the Blood Transfusion subcommittee.

This version is endorsed by the Blood Transfusion sub-committee, Anaesthetic Directorate and Theatre standards group.

Distribution list/dissemination method and references

It is recommended that the guideline be widely available in all clinical areas in the Trust where major perioperative blood loss is managed. This will include the Trust Intranet.

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